

Economics, Policy, Supplies, Forecasts

97/03844 Molten carbonate fuel cell power generation systems

Hishinuma, Y. and Kunikata, M. *Energy Convers. Mgmt.*, 1997, 38, (10-13), 1237-1247.

Over 15 years of research and development of molten carbonate fuel cells (MCFC) have been conducted by Hitachi Ltd. under contracts with the Agency of New Energy and Industrial Science (NEDO). A 100 kW MCFC test plant has already been completed and in 1994 a 1000 kW pilot plant was built. Features of MCFC power generation systems are the high plant efficiency and environment friendly characteristics. Fifty-five per cent efficiency is expected with LNG and 50% with coal. To accelerate commercialization of MCFC plants, Hitachi has studied systems suitable for distributed and large scale power plants and also experimented with fuel cell life tests. The 1000 kW pilot plant will be constructed and tested by 1997 and a 10 MW class demonstration plant will be constructed by 2003.

97/03845 Nickel-zinc batteries with long cycle life

Pavlov, A. P. *et al.* *J. Power Sources*, 1997, 62, (1), 113-116.

The nickel-zinc battery, and its associated problems, are described. A new method of destruction of dendrites in the nickel-zinc battery is proposed, based on a thin high-porous nickel membrane inserted between the electrodes. The chemical reactions of dendrite destruction on this membrane are presented. Cycle life of more than 500 cycles has been achieved during the tests.

97/03846 Partial oxidation of methane in solid oxide fuel cells: an experimental evaluation

Antonucci, V. *et al.* *J. Power Sources*, 1997, 62, (1), 95-99.

A 150 W tubular solid oxide fuel cell stack prototype, directly fuelled by methane, was studied and its operation results are presented. Fuel was partially oxidized to synthesis gas as an alternative route to steam reforming. Over 3000 hours of performance analysis, has been completed to prove the feasibility of the process.

97/03847 Performance characterization of sintered iron electrodes in nickel/iron alkaline batteries

Periasamy, P. *et al.* *J. Power Sources*, 1997, 62, (1), 9-14.

Due to its low internal resistance, a nickel/iron storage battery with a porous, sintered, iron negative electrode and a nickel positive electrode is a high power system. A dry-powder sintering procedure is used to fabricate negative and positive electrodes. Negative iron electrodes are activated with various salt solutions, while positive electrodes are impregnated with nickel hydroxide by a chemical method. Tests are performed in 10 Ah capacity nickel/iron cells and two types of activated iron electrodes are used. Topics addressed include electrode fabrication, charge/discharge studies, self-discharge, temperature performance and cycle life. Finally, the best iron electrodes are coupled with nickel electrodes to obtain a 1.37 V, 75 Ah nickel/iron cell and its performance is discussed.

97/03848 Performance of a model treble-tripler saturated reactor

O'Kelly, D. *Electric Power Systems Research*, 1997, 41, (1), 29-34.

A treble-tripler saturated reactor was simulated by a small laboratory scale model. Results reveal satisfactory agreement between computed and experimental values and illustrate the large change of current for a small voltage change together with low harmonic generation. Unbalanced voltage energization produces a corresponding negative-phase sequence current in the supply with a significant third harmonic component.

97/03849 Studies of natural gas and biomass fueled MCFC systems

Kivisaari, T. *Proc. Electrochemical Soc.*, 1997, 97-4, 179-190.

The methods, techniques and results obtained during the studies of two different MCFC systems within the Swedish MCFC programme are presented. The first power plant is a natural gas fired 1000 kW unit for combined heat and power generation with external reforming. The second is a 40 MW system utilizing biomass (i.e. wood chips) as the primary fuel. Pressurized gasification converted the biomass to gaseous form. Conventional low-temperature gas purification techniques are considered in this work for gasified biomass purification. Both studies were carried out using Aspen Plus and Model Manager.

97/03850 Test results for fuel-cell operation on landfill gas

Spiegel, R. J. *et al.* *Energy*, 1997, 22, (8), 777-786.

A fuel-cell (FC) energy recovery demonstration and landfill gas emissions control results are presented. Two major issues are of concern in this study: (1) the design, construction, and testing of a landfill-gas cleanup system; and (2) a field test of a commercial phosphoric acid fuel cell power plant operating on cleaned landfill gas. A summary of test results on the cleanup system and FC operational data are given. These results may encourage the use of landfill gas in FCs, one of the cleanest energy-conversion technologies available.

97/03851 The American utility fuel search

Rostorfer, C. R. *Proc. Int. Tech. Conf. Coal Util. Fuel Syst.*, 1996, 21, 267-276.

A review of commercial fuel options for electricity generation.

97/03852 Assessment of transmission cost recovery applying marginal pricing in hydrothermal power systems

Mello, J. C. O. *et al.* *Electrical Power Systems Research*, 1997, 41, (1), 67-74.

An integrated framework to evaluate short-run marginal costs (SRMC) in hydrothermal systems is described. This framework considers the chronological aspects of reservoir operation, transmission constraints, equipment failures, hydrological variation and load uncertainty. The resulting SRMC values are used to calculate circuit revenues, which are then compared with investment requirements. The representation of these probabilistic factors substantially increases revenues, in contrast with the widely reported under-recovery found in studies which only represent normal operating conditions. Case studies with the Brazilian north-north-eastern system are also presented and discussed.

97/03853 Domestic merger policy in an international oligopoly: the Nordic market for electricity

Sørgard, L. *Energy Economics*, 1997, 19, (2), 239-253.

Many domestic markets are becoming integrated in international markets. The paper asks if this is an argument for permitting mergers between domestic producers. It is shown that a merger with no cost-saving effects will always be detrimental to domestic welfare if the country is an importer of the product in question, and may increase welfare if the country is an exporter and the price cost margin is sufficiently low initially. We specify a general condition for a merger to improve welfare, and apply the condition on the Nordic market for electricity. Numerical calculations suggest that in this particular market the Norwegian competition authority should ban domestic mergers with no cost savings.

97/03854 The efficiency of the National Electricity Board in Malaysia: an intercountry comparison using DEA

Yunos, J. M. and Hawdon, D. *Energy Economics*, 19, (2), 255-269.

Appropriate operation and management of power industries remains one of the most pressing questions facing developing countries and the international agencies that finance their economic programmes. This paper focuses on one aspect of economic performance, namely the efficiency with which electricity is generated. Evidence suggests that changes in the organization of electricity generation can be justified on efficiency grounds. Data envelopment analysis (DEA) is used to compare the performance of Malaysia's National Electricity Board with those of other countries in a similar stage of development, as well as with that of the UK.

97/03855 Estimation of energy recovery and reduction of CO₂ emissions in municipal solid waste power generation

Otoma, S. *et al.* *Resources, Conservation and Recycling*, 1997, 20, (2), 95-117.

Electricity generated from waste incineration heat requires the addition of generating equipment and the manufacture, construction, and operation of this equipment also uses energy. Superheater tube corrosion caused by the hydrogen chloride and other substances found in conjunction with waste combustion, means that municipal Solid waste (MSW) power generation is unable to effect a great increase in steam temperature and generating efficiency is said to be low. However, in terms of life cycle energy balance, MSW generation is about the same as currently operating commercial power plants. Life cycle energy balance, in relation to repowering and reburning and these were found to be effective methods for energy recovery. In addition, gas turbines combined with waste incinerators for repowering have an optimum size that will improve overall efficiency.

97/03856 Investigating strategies to reduce CO₂ emissions from the electricity sector: the case of Greece

Vassos, S. and Vlachou, A. *Energy Policy*, 1997, 25, (3), 327-336.

CO₂ emissions reduction strategies from the electricity sector are investigated in this paper. In particular, it explores possibilities on the supply side and the significance of demand-side changes. It uses an economic engineering model for electricity generation capacity expansion which combines stochastic simulation for production-cost calculations and dynamic programming for selecting the optimum expansion plan. The model is used to investigate optimal strategies for stabilizing CO₂ emissions from the electricity sector in Greece; these accounted for 50% of CO₂ emissions produced in the country in 1990. It is also used to estimate the optimal tax required to achieve the optimal strategy for controlling CO₂ emissions to the desired level.